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Systematic Review of the Relationship Between Childhood Injury and Socio-economic Status

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Systematic Review of the Relationship Between Childhood Injury and Socio-economic Status

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Table of Contents

Executive Summary i

Chapter 1 Introduction 1
1.1 Socio-economic Status 2
1.2 Systematic Review 2
1.3 Description of Report 3

Chapter 2 Goals and Objectives 5
2.1 Goals 5
2.2 Objectives 5

Chapter 3 Methods 7
3.1 Systematic Review 7
3.1.1 Search to identify published literature 7
3.1.2 Selection of eligible documents 9
3.1.3 Data extraction, quality assessment of included studies ... 10
3.2 External Consultation Process 11

Chapter 4 Results 13
4.1 Results of Searches for Documents 13
4.2 Synthesis 13
4.2.1 Study characteristics 13
4.2.2 Randomized controlled trials 14
4.2.3 Non-randomized controlled trials 14
4.2.4 Cohort studies 15
4.2.5 Case-control studies 15
4.2.6 Pre-post studies 16

4.3 Intervention Studies 16
4.3.1 Child passenger restraint use 16
4.3.2 Bicycle helmet use 17
4.4 Analytical Studies 17
4.4.1 Risk factors for general injury 17
4.4.2 Risk factors for pedestrian injury 18
4.4.3 Risk factors for bicycling injury 19
4.4.4 Risk factors for poisoning 20
4.4.5 Risk factors for burns 20
4.5 Canadian Studies 21

Chapter 5 Discussion 23
5.1 Measures of SES 23
5.2 Methodological Quality 24
5.3 SES Measures: Which Is Most Informative? 25
5.4 Multiple Factors 25
5.4.1 Parenting 25
5.4.2 Economics 26
5.4.3 Environment 27
5.5 Programming and Policy: Where Do We Go from Here? 27
5.6 Limitations of This Review 28

Chapter 6 Conclusions and Recommendations 29

References 33

PLEASE NOTE:
Appendices are available upon request through Health Canada by fax at (613) 954-3358 and are available in English only.

Executive Summary

Unintentional injuries are the leading cause of death in children and adolescents in Canada and a major cause of morbidity. Evidence has shown that these injuries are not the "accidents" we tend to dismiss as unlucky or unfortunate, but predictable events that are frequently preventable. Assessing the most effective injury prevention strategies requires an understanding of the factors that contribute to both injury occurrence and compliance with injury prevention measures (e.g. bicycle helmet use). The significance of the evidence on these factors and any resulting policy decisions is becoming more apparent as injury control practitioners debate whether injury prevention programming should target a whole population or be adapted for a specific population of interest, such as "high-risk" groups. As this debate heats up, the need for a clearer understanding increases.

The link between economic prosperity and child health is very well established.[5] In 1991, 18% of Canadian children under the age of 18 were living in poverty, and those living in the poorest income areas were at the greatest risk of dying from injuries.[1] However, the evidence has not been systematically reviewed to allow an understanding of the specific relationship between socio-economic status (SES) and childhood injury. Such a scientific synthesis is an important starting point for evidence-based programming, policy making and future research agendas. Health Canada commissioned a systematic review of the published literature examining this potential association in early 1998. The specific objectives of the project were to:

- describe the types of measures of SES used in the study of childhood injury;
- assess the quality and nature of evidence regarding the relationship between SES and the incidence of childhood injury; and
- assess the evidence regarding the relationship between SES and the uptake of injury-preventing measures or behaviours.

Systematic reviews require explicit and reproducible methods for identifying and selecting studies, grading them as to their eligibility and quality of reporting, and extracting and systematically synthesizing the information. They therefore provide the most reliable method for synthesizing research evidence. In this review, an electronic search strategy was developed to retrieve published research studies. In addition, the *International Journal of Injury Prevention*, reference lists from any identified reviews and relevant articles, and three existing injury-related reference databases were hand reviewed. International injury prevention experts were also contacted in an attempt to locate any previously unidentified or unpublished studies. Potential articles were selected based on a set of inclusion criteria; articles included were assessed as to their quality of reporting and relevant information was extracted.

The combined search identified 4622 documents, of which 1159 were duplicates. Of the remaining 3463 documents, 429 were considered potentially relevant to our review and 57 met all inclusion criteria and were included in the synthesis. The majority of these studies were rated as having low quality of reporting; either study designs were weak or information required to assess potential for bias was not reported. When measures of SES included in the potentially relevant studies were examined, 47 different measures were used, most with several different operational definitions. The most frequently used measures were ethnicity, maternal or paternal education, and household income; however, 21 of the 47 measures (45%) were used less than three times. The variety in both measures and operational definitions made synthesis of the SES evidence difficult.

Eighteen (32%) of the 57 studies included in the synthesis were intervention studies (4 randomized controlled trials [RCT], 12 non-randomized controlled trials [NRCT], and 2 pre-post). These studies covered several topics under motor vehicle collisions (seat belt use, drunk driving incidence, and child passenger restraint use), as well as bicycle helmet use, pedestrian safety, scald prevention, and general home safety. None of the studies specifically addressed whether SES affected uptake of prevention measures (e.g. use of a bicycle helmet or car restraint) as a primary research question. Child passenger restraint use and/or correct use was the focus of four of the NRCTs and lower SES was associated with lower restraint use and/or correct use regardless of whether participants were in the intervention or control groups in all four studies. Bicycle helmet use was the focus of four of the NRCTs and the two pre-post studies. One of the NRCTs found no association with SES, two found increased helmet use among children of higher SES and the fourth found that African-American children were less likely than white children to wear helmets, but found no association with income tertiles. Helmet use was associated with higher income and white race in both pre-post studies.

The remaining 39 studies (13 cohorts and 26 case-control studies) investigated risk factors for several injury types: pedestrian, cycling, poisoning, burns/scalds, home, traffic, tobogganing and overall unintentional injuries (general injury). Several of these studies specifically addressed the influence of SES factors on injury.

- Risk factors for general injury were the focus of the majority of the cohort studies (9/13) and six of the 26 case-controls. SES-related results were discordant, with some finding no increased risk based on SES, others finding those of lower SES at increased risk and one finding children of mothers with higher levels of education at greater risk.
- Risk factors for pedestrian injury were the sole focus of nine of the case-controls. Three others examined risk factors for both pedestrian and cycling injuries. The majority of the studies found lower SES to be associated with increased risk of pedestrian injury, although there was some discordance with respect to family size.

- Risk factors for bicycling injury were the sole focus of two of the case-controls while three others examined risk factors for both bicycling and pedestrian injuries. SES-related results were discordant. Several studies found lower SES to be associated with an increased risk of bicycle-related injury, while others found no association.
- Risk factors for poisoning were the focus in two cohorts and three case-control studies. Again SES-related results were discordant with no clear pattern emerging.
- Risk factors for burns were the focus in two case-control studies. One found an increased risk for lower SES; the other found no associations.

Only six (11%) of the studies were Canadian (3 analytic, 3 intervention). The analytic studies found an increased risk of injury for those in lower SES categories and uptake of preventative measures was higher for those in higher SES categories in the intervention studies. However, due to the small number of studies, conclusions are difficult.

Following an extensive search, this systematic review found 57 relevant studies that examined the relationship between childhood injury and SES status. Few of these studies primarily examined this relationship, with most including SES measures as possible confounds or co-factors. Based on the reporting of these studies, the majority were methodologically weak and open to substantial bias. Further, the many different measures of SES used in these studies make it difficult to synthesize results. Despite this, there is enough evidence presented in these studies to compel continued study into this issue. There is also enough evidence to suggest a need for policy and program planners to take the SES issue into account when designing injury prevention policies and programs for Canadian children and youth. The specific recommendations stemming from this review are:

1. A standardized set of measures of SES and/or a Canadian index should be developed and distributed so that all researchers are using the same measures.
2. All injury prevention programs – their strategies (educational, engineering, legislative) and their evaluations – should take into account the SES of the target population.
3. Injury prevention program planners need to develop innovative initiatives designed to increase uptake of safety measures and decrease environmental hazards in lower SES populations.
4. RCTs should be considered the preferred research design for investigating injury control interventions; other designs should be used when an RCT is impossible to implement.
5. Specific standards for reporting of non-RCT intervention studies and analytic epidemiological studies should be developed.

6. A coordinated national research agenda that focuses on understanding the mechanism(s) by which SES status leads to an increased injury incidence and lower uptake of safety measures should be developed.

7. Health Canada should establish an infrastructure for a national network of collaborating childhood injury control research centres with sufficient funds to design and conduct epidemiological and program evaluation in childhood injury.

Introduction

Chapter 1

Unintentional injuries are the leading cause of death in children and adolescents in Canada and a major cause of morbidity.[1] Evidence has shown that these injuries are not the "accidents" we tend to dismiss as unlucky or unfortunate, but are predictable events that are frequently preventable.[2] A recent report estimating the total cost of illness in Canada in 1993 indicated that $14.3 billion or 11.1% of the total burden of illness was due to injury.[3] Although the report did not break this amount down by age group, a recent article from the United States showed that the largest source of child medical spending after birth is injuries.[4] Thus, in addition to saving lives, injury control has great potential to save money.

Assessing the most effective prevention strategies for a particular type of injury requires an understanding of the factors that contribute to both the occurrence of the injury and the uptake of, and compliance with, potential prevention strategies (e.g. bicycle helmet use). One of the current issues in injury prevention is the gap that exists between what is known about these factors and the use of that information in programming and policy making. How can injury prevention practitioners and politicians make evidence-based decisions when there are hundreds of research studies of varying methodological quality examining a particular issue? Realistically, they cannot. Therefore, there is a need to ensure that the priority attached to research is translated into evidence-based programming and policy making through synthesis and dissemination of the research.

The link between economic prosperity and child health is very well established.[5] In 1991, 18% of Canadian children and youth under the age of 20 were living in poverty, and those living in the poorest income areas were at the greatest risk of dying from injuries.[6] One of the remaining controversies is whether prevention programming should target a whole population or specific "high-risk" groups. As this debate heats up, the significance of the evidence and the resulting policy decisions will become more apparent. Preliminary review of published studies suggests that if a substantial reduction in unintentional childhood injury is to be achieved, a fuller understanding of the influence of socio-economic status (SES) is of prime importance.

1.1 Socio-economic Status

SES is a somewhat nebulous concept. It is a descriptive term for an individual's position in society, which is often expressed on an ordinal scale using such criteria as income, occupation or educational level attained.[7] The variables used to measure social class vary greatly from study to study – ranging from a commonly used indicator such as income to one as obscure as a child's use of a lunch subsidy. Since no synthesis of such research has ever been conducted to provide program planners and policy makers with an overview of the available evidence, it is unclear whether enough evidence has been amassed to allow an understanding of the relationship between SES and injury. Such a synthesis is an important starting point for evidence-based programming and policy making in any health care area.[8]

1.2 Systematic Review

One approach to summarizing the existing evidence regarding the effects of a health determinant on a specific outcome is to perform a systematic review. This approach uses explicit and reproducible methods for identifying and selecting studies and grades each eligible study with respect to the strength of evidence it contains. Information from each study is then extracted. Because of the rigorous, explicit and reproducible way in which the systematic review is conducted, it provides the most reliable method for synthesizing research evidence. This approach enables the collection of high quality data that will act to separate dogma and mythology from fact. The systematic review has gained wide-scale acceptance within health care and the social sciences as the most valid way to synthesize accumulated evidence.[9] Within the last 10 years, the number of published reviews has increased 500-fold,[10] and several have been within the child injury domain.[11] Although most experience with systematic reviews has been with reviews of randomized controlled trials (RCTs), the same principles apply to reviews of areas of research or inquiry where few, if any, RCTs have been done.

The history of the injury field has been marked by studies that are nearly all of the same type – descriptive epidemiology. More recently, there has been an increase in the use of analytic epidemiologic studies such as cohort and case-control designs used to discern associations between injuries and possible risk factors. By suggesting causal relationships or identifying high-risk characteristics associated with that causal relationship, these studies provide the basis for developing intervention strategies.[12] The other important area of study has been the evaluation of prevention programs. RCTs have been completed in the area of injury prevention and have distinct advantages, such as reducing both known and unknown bias, yet numbers are limited. Due to the nature of injury interventions (education/behaviour change strategies, enforcement of legislation/policy and engineering/product and environmental modifications), some researchers and program evaluators believe that randomized trials are not feasible. As a result, many programs are not as rigorously evaluated as they could be. For this reason, methods other than RCTs are of interest in examining the relationship between SES and childhood injury.

A systematic review of published Canadian and international literature and unpublished studies identified through contact with international injury experts is reported here. This review explored the measures of SES used in childhood injury studies and the evidence available regarding the relationship between SES and unintentional childhood injury and its prevention.

1.3 Description of Report

This report begins by outlining the goals and objectives of the project, summarized in Chapter 2. Chapter 3 describes the methods used and a presentation of the results follows in Chapter 4. Chapter 5 contains a discussion of the findings and Chapter 6 summarizes the conclusions and recommendations. References are included and are numbered in the text to coincide with data tables in the appendices. Appendices contain supporting materials and are provided in order of importance.

Goals and Objectives

Chapter 2

2.1 Goals

The goal of this project was to synthesize the research evidence regarding the relationship between SES and unintentional childhood injuries and to determine potential implications for injury prevention research, programming and policy relevant to the Canadian context.

2.2 Objectives

The specific objectives of this project were to:

(1) describe the types of measures of SES used in the study of childhood injury;

(2) assess the quality and nature of evidence regarding the relationship between SES and the incidence of childhood injury; and

(3) assess the evidence regarding the relationship between SES and the uptake of injury-preventing measures or behaviours.

Methods

Chapter 3

The methods used in this review, as with other systematic reviews, are modelled on those used in conducting primary research.[13] Comprehensiveness and detailed accounting of the conduct of the review were emphasized to ensure that it could be replicated. The team conducting the review included representatives from the Thomas C. Chalmers Centre for Systematic Reviews at the Children's Hospital of Eastern Ontario. This Centre's mandate is to teach, conduct and research systematic reviews. Their previous work into systematic review methodologies and instrumentation was invaluable to this initiative.

3.1 Systematic Review

3.1.1 Search to identify published literature

An electronic search strategy based on four questions was developed in collaboration with a librarian at the Canadian Medical Association. The four questions were:

1. What measures of SES have been used in childhood (0–19 years) injury prevention studies?
2. Is SES a risk factor for unintentional injuries in children 0–19 years of age?
3. Does SES have an impact on children's uptake of or compliance with preventing measures or behaviours?
4. Does SES have an impact on the parent/caregiver's uptake of or compliance with preventing measures or behaviours (e.g. bicycle helmet use)?

A search filter (a series of subject-related keywords used to extract potentially relevant articles from a computerized database) for SES was developed and tested. Attempts were made to refine it; however, most of the potential refinements excluded one or more previously identified potentially relevant articles. We searched eight electronic databases using the broad SES filter (Medline, PsychINFO, CINAHL, Current Contents, HealthSTAR, Sportdiscus, Sociofile and EMBASE). All but Sociofile retrieved potentially relevant studies. For all databases, letters, comments/editorials, articles on food poisoning and articles written prior to 1980 were immediately excluded.

The initial search, Search I, was run for only the first three questions (Appendix E1). Separate searches of each of the computerized databases were conducted for injuries in the following categories:

- "SES1": bike, walk, motor vehicle
- "SES2": gun, drown, choke
- "SES3": fall, burn, electrocution
- "SES4": poisoning, cut
- "SES5": sports and amputate

The detailed search strategies for each computerized database can be found in Appendix E1. Current Contents and HealthSTAR use the same strategy as Medline; therefore they are not included as separate search strategies. When references were retrieved by more than one computerized database, priority in entering them into our "search" database was given first to those retrieved by Medline and then to the successive database as listed above. Due to the broad nature of both the search strategy and the content of some articles, many references were retrieved by the searches for more than one of the respective injury categories. In this case, entering priority was given to the category "bike" and then to the categories as listed above. Once this process was complete for the first search, a second search for the fourth search strategy question was run in the same computerized databases implemented in Search I (Search II, Appendix E2).

We also hand searched the *International Journal of Injury Prevention*, reviewed reference lists from any identified reviews and relevant articles, and examined three existing injury-related reference databases:

1. Childhood injury control intervention database maintained by Dr. Terry Klassen at the Children's Hospital of Eastern Ontario in Ottawa, Ontario;
2. Childhood injury database maintained by Dr. Barry Pless at the Montreal Children's Hospital in Montreal, Quebec;
3. Childhood injury control database maintained by Dr. Fred Rivara at the Harborview Injury Prevention and Research Centre in Seattle, Washington.

All three databases were hand searched for articles written after 1980 containing any potential SES measures. Finally, we contacted a group of 10 experts from the injury prevention field (Appendix B1) who were sent a letter (Appendix B2) that asked them to review the list of the studies selected as relevant and add any additional studies of which they were aware. Eight agreed to participate and four were able to provide potential articles. The specific contribution of the *Report on the Socio-economic Influences on Unintentional Injury in Childhood: A Discussion Document prepared for the Child Accident Prevention Trust,* authored by Jackson and Towner, 1997, was particularly helpful.

3.1.2 Selection of eligible documents

Once a single "SES and injury" database of published works was created by merging each respective article source, one member of the team screened each citation, including the abstract when available, using broad criteria for retaining citations in the database. All references referring to injury in children that either mentioned a potential measure of SES or using a study design that included a control group were retained as potentially relevant. Lead poisoning articles were excluded because the topic was viewed as more of a chronic than acute injury and a hazardous environment issue. The initial screening resulted in a smaller number of potentially relevant documents for possible inclusion in the review.

Hard copies of all potentially relevant documents were sought and retrieved where possible. These were further screened to determine which should be included in the review. A set of strict eligibility criteria was used to determine inclusion and exclusion of documents in the review. A document was included if it:

- addressed unintentional injury or unintentional injury control measures (if both intentional and unintentional injury were addressed, unintentional injury had to have a separate data analysis);
- was written or published in any language in 1980 or later;
- was a primary research report targeting children (0–19 years) and/or their parents/caregivers (if a greater age range was addressed, the 0–19-year age group or part thereof had to have a separate data analysis);
- contained an analysis of a potential measure(s) of SES as a variable or confound, was a primary research report that assessed the relationship between SES **and** the incidence or risk of unintentional childhood injury (hospitalizations, deaths, emergency department visits, self-reported injuries), or the uptake of or compliance with injury-preventing measures and or behaviours (excluding changes in knowledge, intentions and attitudes); or
- contained a control group in its methodological design.

Two members of the team trained themselves in using a Relevance Form (Appendix B3) and then independently reviewed all documents to determine the eligibility of each document. These were then reviewed and where there was disagreement, they were resolved by discussion.

3.1.3 Data extraction, quality assessment of included studies

Information from included documents was abstracted using a Data Extraction and Quality Assessment Form (Appendix B4). The extraction portion of the form collected descriptive data about each study, such as the year of publication, country in which the study was conducted, type of injury studied, study time period, study aim, study target group, primary outcome measure, SES measure, key study results and SES-related study results.

The proper planning of an intervention study using quantitative approaches requires that the investigator identify a primary outcome of interest. The primary outcome serves as the main outcome for determining the effectiveness of the intervention and is used as the basis for determining the sample size for the study. When multiple outcomes are analyzed, without an explicitly stated primary outcome, the probability of having a false statistically significant difference (Type I error) in the results increases.[14] For each intervention study, we attempted to abstract the primary outcome, the intervention and relevant data about its results. If it was not clear which outcome was the primary outcome in the studies reviewed, we made as objective a selection as possible by determining which outcome seemed to be the most important or most serious (e.g. helmet use would be more important than helmet ownership, death is more serious than hospitalization).

The quality assessment portion of the form was dependent on the study design. RCTs were evaluated using the Jadad Scale,[15] a validated tool for assessing methodological quality. This tool scores quality from 0–5, with the highest score/quality of five. Validated instruments are not available for other study designs. Because the Jadad Scale includes questions on randomization, blinding, and dropouts and withdrawals, questions ascertaining whether participant groups were homogeneous, whether bias was introduced in measurement of exposure, and outcome or differential follow-up were asked of the other designs. Two members of the team independently completed the data extraction and quality assessment for each relevant study. These were then reviewed and disagreements were resolved by discussion. In addition, all articles containing a measure of SES and targeting a childhood population or their parents/caregivers, whether included in the review or not, were examined to provide a complete list of SES measures used in studies of childhood injury.

3.2 External Consultation Process

The second phase of this project involved a consultation process. External experts were invited to provide input into our report. Key opinion leaders were selected in conjunction with Health Canada to represent the areas of injury epidemiology, injury prevention programming, injury prevention policy and the social welfare perspective. In addition, consideration was given to ensuring participation from regions across Canada. Eleven experts were approached (Appendix B5) and were sent a letter (Appendix B6) to provide details of the process. Nine experts agreed to participate, six provided feedback. The participating experts were sent a copy of the draft report and were asked to provide feedback and comment specifically on the draft recommendations. Their feedback has been incorporated into the final report.

Results

Chapter 4

4.1 Results of Searches for Documents

Our combined search identified 4622 documents, of which 1159 were duplicates. Flow diagrams are appended in Appendix C1. The remaining 3463 documents were included in our "search" SES and injury database. Eighty-four percent of the articles were found in Medline (Appendix C2). Our initial screen identified 485 documents of potential relevance to our review, of which 429 were articles containing original data and 56 were reviews.

4.2 Synthesis

Of the 429 original articles deemed potentially relevant, 57 were included in the review,[16-72] 15 could not be obtained* and 357 failed to meet the inclusion criteria. The reasons for excluding studies are presented in Appendix C5. Article-specific reasons are provided in the bibliography. The most common reasons for excluding documents were that they did not contain a measure of SES (189) and/or their study design did not contain a control group (255). The inter-reviewer reliability analysis documented substantial agreement between both reviewers[73] regarding final eligibility (intra-class correlation coefficient = 0.68).

4.2.1 Study characteristics

Of the 57 studies included, 18 were intervention studies (4 RCTs[16-19], 12 non-randomized controlled trials [NRCT][20-31] and 2 pre-post [71-72]), and 39 were analytical studies (13 cohorts[32-44] and 26 case-control studies[45-70]). The inter-reviewer reliability resulted in substantial agreement between reviewers regarding study design[73] (intra-class correlation coefficient = 0.75). Most included studies were published between 1990 and 1998 (n=39, 68%) and were conducted in the United States (n=26) and the United Kingdom (n=7). Only six (11%) were carried out in Canada. All were published in English. The injury type on which the study focused varied by study design (Table 1). The majority of intervention studies focused on preventive strategies in bicycling or motor vehicle collisions, while most analytical studies focused on unintentional injury in general or on pedestrian injuries. A graph of injury type can be found in Appendix C4.

* The 15 articles not available were requested through the interlibrary loan service but had not arrived by the three-month cut-off.

Table 1 — Study design by injury type for included studies

Injury Type Studied	Intervention Studies			Analytical Studies	
	RCT	**NRCT**	**Pre-Post**	**Cohort**	**Case-Control**
General	1	–	–	9	6
Pedestrian only	–	–	–	–	9
Bicycling only	–	5	2	–	2
Pedestrian & bicycling grouped	–	–	–	–	3
Motor vehicle collision	1	6	–	–	–
Poisoning	–	–	–	2	3
Fire/Burn	2	–	–	–	2
Other	–	1	–	2	1
TOTAL	**4**	**12**	**2**	**13**	**26**

4.2.2 Randomized controlled trials

Four RCTs were included in the review (see RCT Tables 1-5, Appendix A). Two evaluated measures to prevent burns,[17,18] one evaluated a high school driver education course[16] and the fourth evaluated measures to prevent home injuries[19] (RCT Table 1). Sample size ranged from 55 to 16 338 (median=291, interquartile range (IQR)=68-8419) (RCT Table 4). The quality of reporting of all four trials was very low as determined by the Jadad Scale. Two studies had a total score of 1/5 or 20% of the maximum possible score of five,[16,18] while the two other studies each had a total score of 2/5 or 40% of the maximum score available[17,19] (RCT Table 5). There was total agreement between observers that there was a high-risk of bias (0-2 points) in all four studies.

4.2.3 Non-randomized controlled trials

Twelve NRCTs were included in the review (see NRCT Tables 1-5, Appendix A). Six evaluated measures to decrease motor vehicle–related injuries,[25-30] four evaluated measures to increase bicycle helmet use,[20-23] one evaluated a measure to decrease bicycle riding without supervision[24] and one evaluated measures to prevent home injuries[31] (NRCT Table 1). Sample size ranged from 93 to 9 827 (median=1135, IQR=187-4359) (NRCT Table 4). Quality of reporting was evaluated using four questions assessing whether participants were blind to their allocation; outcome

assessors were blind to participant allocation; participants in intervention and control groups were similar; and the number of and reasons for study withdrawal were reported. Participants were aware of their allocation in five (42%) of the NRCTs;[20,22-24,31] outcome assessors were aware of participants' allocation in 10 (83%);[20-25,27,28,30,31] there was no evidence presented that participants were similar in each group in eight (67%);[22,23,25-29,31] and information on withdrawals was unavailable in eight (67%)[20-24,26,27,29] (NRCT Table 5). As such, the quality of reporting in most of these studies was considered low.

4.2.4 Cohort studies

There were 13 cohort studies included in the review (see Cohort Tables 1-5, Appendix A). Most of these studies generally addressed risk factors for injury in children (9/12 or 75%)[34-42] (Cohort Table 1). Sample size ranged from 32 to 1 500 000 (median=587, IQR=271-1251) (Cohort Table 4). Quality of reporting of cohorts was evaluated using four questions assessing whether exposure assessment was the same for all participants; outcome assessment was the same for all participants; outcome assessors were blind to exposure status; and whether the number of and reasons for study withdrawals were reported. Exposure and outcome assessment was the same for all participants in all of the cohorts; outcome assessors were aware of participants' exposure in all of the cohorts; and information on withdrawals was not reported in any of the cohorts (Cohort Table 5). These results suggest that there is a risk of bias in these studies.

4.2.5 Case-control studies

Twenty-six case-control studies were included (see Case-Control Tables 1-5, Appendix A). Most of these studies addressed risk factors for bicycle and/or pedestrian injuries (14/26 or 54%)[45-58] or generally addressed risk factors for injuries (6/26 or 23%)[65-70] (Case-Control Table 1). Sample size ranged from 51 to 1220 (median=279, IQR=210-430). The ratio of cases to controls was 1:1 in 46% of the studies,[45,46,51,53,59,63,65-70] 1:2 in 42%[48-50,52,54,60-62,64] and 1:3 in 12%[47,56,58] (Case-Control Table 4). Quality of reporting of case controls was evaluated using four questions assessing whether exposure assessment was the same for cases and controls; exposure assessors were blind to case-control status; cases and controls were from the same population; and the number of and reasons for study withdrawals were reported. Exposure assessment of cases and controls was assessed to be different in five[45,58,60,64,70] (19%) of the studies and exposure assessors were blind in only two[48,53] (8%). Controls were assessed by the reviewers not to be from the same population as cases in eleven (42%) of the studies[45,50,51,54-60,67] and information on withdrawals was reported in nine (35%) of the studies[45,46,51,55,56,58-60,63] (Case-Control Table 5). Again, these results suggest that there is a risk of bias in these studies, particularly interviewer bias.

4.2.6 Pre-post studies

Two pre-post studies were included (see Pre-Post Tables 1-5, Appendix A), both of which examined the effect of legislation on bicycle helmet use[71,72] (Pre-Post Table 1). Sample sizes for the two studies were 242 and 182 (Pre-Post Table 4). Quality of reporting of pre-post studies was evaluated using four questions assessing whether outcome assessment was the same for all participants; outcome assessors were blind to allocation; and the number of and reasons for study withdrawals were reported. Outcome assessment was the same for all participants in both studies, outcome assessors were aware of participants' allocation in both studies and information on withdrawals was not reported in either of the studies (RCT Table 5). These results suggest that there is a risk of bias in these studies.

4.3 Intervention Studies

About 28% of the studies were intervention studies (RCT, NRCT and Pre-Post studies). These studies covered several topics under motor vehicle collisions (seat belt use, driving under the influence, child passenger restraint use), as well as bicycle helmet use, pedestrian safety, scald prevention, and general home safety. None of these studies specifically addressed whether SES affected uptake as a primary research question. If there was more than one study in a particular topic area, we attempted to synthesize the results.

4.3.1 Child passenger restraint use

Child passenger restraint use and/or correct use was the focus of five of the intervention studies, all of which were NRCTs.[25-27,29,30] All of the studies were from North America, including one from Canada[29] (NRCT Table 1). Interventions ranged from car loaner programs[29] to computer-assisted interactive video presentation, demonstration and educational material[25] to video plus face-to-face instruction.[30] Observed restraint use was the outcome in all but one of the studies. The other used self-reported use.[25] SES data were collected through school records,[26] self-report questionnaires[30] and telephone interview[25,29] (NRCT Table 2). Measures of SES and operational definitions varied among studies (NRCT Table 3).

In all cases, lower SES was associated with lower restraint use and/or correct use, regardless of whether participants were in the intervention or control group (NRCT Table 4).

4.3.2 Bicycle helmet use

Bicycle helmet use was the focus of four of the NRCTs[20-23] and the two pre-post studies.[71,72] All of the studies were from North America, including two from Canada[21,22] (NRCT Table 1, Pre-Post Table 1). Two of the NRCT interventions were school-based[22,23] and two were community-based with a focus on schools.[20,21] The two pre-post studies examined the impact of helmet legislation. SES data were collected through self-report questionnaire,[23] census data,[20,22,71] telephone interview[72] and community of residence.[21] Observed helmet use was the outcome in three of four of the NRCTs[20-22] and one of the pre-post studies.[71] Self-reported helmet use was used in the remainder[23,72] (NRCT Table 2, Pre-Post Table 2). Measures of SES and operational definitions varied greatly among studies (NRCT Table 3, Pre-Post Table 3).

One of the NRCTs found that injury outcome was not associated with the Hollingshead Social Position Index.[23] Two of the NRCTs found increased helmet use among children of higher SES.[21,22] The fourth found an association with race but not with income tertiles.[20] In the case of the pre-post studies, helmet use was associated with higher income and Caucasian race[71,72] (NRCT Table 4, Pre-Post Table 4).

4.4 Analytical Studies

The remainder of the included studies were analytical (72%) and included risk factors for several injury types: pedestrian, cycling, poisoning, burns/scalds, home, traffic, tobogganing and overall unintentional injuries (general injury). Several of these studies specifically addressed the influence of socio-economic factors on injury.

4.4.1 Risk factors for general injury

Risk factors for general injury were the focus of most of the cohort studies (9/13)[34-42] and six of the 26 case controls.[65-70] Eight of the studies were from North America, including one from Canada,[38] five were from the United Kingdom,[37,41,66,68,69] one was from New Zealand[34] and one was from Thailand[70] (Cohort Table 1, Case-Control Table 1). All but one of the cohorts was general in focus (i.e. they focused on risk factors for the host and in the social and physical environments)[34,36-42] and two focused specifically on the first three years of life.[38,39] The other cohort examined socio-economic factors and childhood aggression.[35] The outcome measure was an injury requiring medical care for five of these studies,[34,37-39,42] injury death in the first four years of life for one,[40] injury incidence for two,[35,36] and an injury event for another[41] (Cohort Table 2). All of the case-control studies were general in focus (they examined factors in the host, social and physical environment). The outcome in the case-control studies was injuries seen in an emergency room in all but one study, which used injury death in the first year of life[67] (Case-Control Table 2). SES data were collected through

personal interviews,[34-36,39,41,68,70] self-report questionnaires,[37,65,66] census data,[66,67] birth certificates,[40] death certificates,[67] form completed by physician,[42] telephone interview,[38] and observation and zip code[69] (Cohort Table 2, Case-Control Table 2). Measures of SES and operational definitions varied greatly among studies (Cohort Table 3, Case-Control Table 3).

The SES results of the cohort studies were discordant. Two studies revealed that no measure of SES played a significant role in determining risk.[35,36] Yet, another study reported that families in low SES areas experienced more injuries than those in areas of high SES.[41] One study found that SES was no longer significant once maternal and home characteristics had been controlled.[39] Another study showed that children whose parents made a lower yearly income and children from a single-parent household were at increased risk of injury.[42] Children of mothers with lower educational levels were at increased risk in one study that found family size, ethnicity and maternal employment did not play a significant role in childhood injury outcomes.[34] Two other studies indicated that children of unemployed mothers were at greater risk[38,40] (Adj. RR 1.8 {95% CI=1.3-2.3} and no RR reported), one of which found no increased risk for lower income and poorly educated mothers[38] (Cohort Table 4).

Study results were discordant among the case-control studies. No differences by SES measures were found in two of the studies;[66,69] however, children with mothers with more than high school education were at a greatly increased risk in one study[65] (Adj. RR 9.7 {95% CI=1.1-89.2}). Low parental education (Crude OR 2.1 {95% CI=1,3-3.3}) as well as family size (Crude OR 3.4 {95% CI=1,4-8.5}) were associated with injury in another study.[70] The remaining two studies found children were at higher risk if their mothers were African-American (Adj. RR 2.1 {95% CI = 1.0-4.5}), they lived in a rural residence (Adj. RR1.9 {95% CI=1.0-3.7}), they belonged to a lower social class, their fathers were unemployed, or if their mothers were less likely to be working outside the home[67,68] (Case-Control Table 4).

4.4.2 Risk factors for pedestrian injury

Risk factors for pedestrian injury were the sole focus of nine of the case-control studies.[50-58] Three others examined risk factors for both pedestrian and cycling injuries.[47-49] Six of the studies were from North America,[48-53] including two from Canada,[48,49] five were from Australia,[57-58] or New Zealand[54-56] and one was from the United Kingdom[47] (Case-Control Table 1). Four of the studies examined host factors (race;[52] impulse control and/or vigilance;[49] hyperactivity,[51] general characteristics[47]), two examined factors in the social environment (child of single parent,[54] family cohesion[51]), four examined factors in the physical environment[50,53,55,57] and three were general in focus (host, social and physical environments).[48,56,58] The outcome measure for case selection was death or hospital admission due to a pedestrian injury in five of the studies,[50,53-56] pedestrian injury hospital admission in two,[52,57] pedestrian injury resulting in a hospital visit in two,[51,58] pedestrian injury-related emergency room visit in two[47,49] and pedestrian injury in one.[48] SES data were collected through personal interview,[54-58] self-report questionnaire,[48,49,51] observation,[50] hospital record[52] and

census data.[53] The method used to collect SES was unclear in one of the studies[47] (Case-Control Table 2). Measures of SES and operational definitions varied greatly among studies (Case-Control Table 3).

African-American children (Crude OR 2.95 {95% CI=1.54-5.89},[52] Maori children (Adj. OR 2.92 {95% CI=1.02-8.35})[56] or children coming from environments judged as of low or intermediate safety (Adj. RR 3.4 {95% CI=2.0-5.6}),[48] lower SES [lower Green score;[49] low Social Index (Crude OR 17.04 {95% CI=1.50-192.0}),[57] and Elley Irving Scale (Crude OR 2.32 {95% CI=1.77-4.51}[54]) were reported to be at higher risk for pedestrian injury. Children from economically poor families,[47] families with household income lower than $20,000 (Crude OR 7.0 {95% CI=2.3-21.2}),[53] families with no private insurance (Crude OR 2.38 {95% CI=1.24-4.56}),[52] no car access (Crude OR 2.35 {95% CI=1.60-3.46},[54] Adj. OR 1.97 {95% CI=1.06-3.66})[55] or living in multifamily residences (Crude OR 3.1 {1.3-7.6})[50] were also at increased risk. In addition, while one study found no effect of family size,[48] two others found families with 3 children under five years (Adj. OR 3.36 {95% CI=1.19-9.50})[56] and families with 5+ siblings (Crude OR 2.90 {95% CI=1.68-5.03})[54] to be at increased risk of injury. One study reported a U-shaped relationship between SES and pedestrian injury with higher risk for low and high SES groups, but the results were non-significant[58] (Case-Control Table 4).

4.4.3 *Risk factors for bicycling injury*

Risk factors for bicycling injury were the sole focus of two of the case-control studies[45,46] while three others examined risk factors for both bicycling and pedestrian injuries.[47-49] Two of the studies were from North America, both from Canada[48-49], two were from Australia[45,46] and one was from the United Kingdom[47] (Case-Control Table 1). Four of the studies were general in focus[45,46,48,49] (host, social and physical environments) and one focused on host factors.[47] The outcome measure for case selection was bicycle injury-related emergency room visits for all but one of the studies, which used bicycle injury as recorded in medical records.[48] SES data were collected through personal interview[45,46] and self-report questionnaire.[48,49] The method used to collect SES was unclear in one study[47] (Case-Control Table 2). Measures of SES and operational definitions varied greatly among studies (Case-Control Table 3).

Children from lower income categories (Crude OR 4.3 {95% CI=1.8-10.4}[45] and Crude OR 3.2 {95% CI=1.5-6.6} @ <$20,000),[46] lower SES (lower Green score)[49] or economically poor families[47] were at increased risk for bicycling injuries. Parents' education level was non-significant in one study[45] and significantly increased risk of injury in another (Crude OR 3.3 {95% CI=1.5-7.6}) for parents with only a primary school education).[46] A third study found having a mother with 12+ years of education to decrease risk (Adj. RR 0.5 {95% CI=0.3-0.8}).[48] Three studies examining family size (number of children or siblings) found no association[46-48] (Case-Control Table 4).

4.4.4 Risk factors for poisoning

Risk factors for poisoning were the focus of study in two cohorts[32,33] and three case-control studies.[61-63] The cohort studies were from Greece[33] and the United States[32] and the case-control studies were from Malaysia[61,62] and New Zealand[63] (Cohort Table 1, Case-Control Table 1). One study examined differences between parents who used and failed to use a poison control centre,[32] and the remaining studies were general in focus (host, social and physical environments).[33,61-63] The outcome measure in the cohort studies and for case selection in the case-control studies was hospitalization due to poisoning. SES data were collected through personal interviews in one of the cohorts[33] and all the case-control studies[61-63] (Cohort Table 2, Case-Control Table 2). The remaining cohort obtained SES data through telephone interviews.[32] Measures of SES and operational definitions varied greatly among studies (Cohort Table 3, Case-Control Table 3).

Both case-control studies from Malaysia found an increased risk of poisoning for Indian children (lowest SES group) (Crude OR 3.2 {95% CI=1.6-6.2}).[61] One of these studies also found no difference with regard to parental education or family income.[62] The case-control study from New Zealand found no association with measures of SES (occupation, employment status, accommodation or single-parent family status) except for families with more than four children.[63] The cohort study from Greece found an increased risk for children with less educated fathers, living in more crowded conditions and from lower income families, but no differences by family size, number of siblings, maternal education, parental occupation or number of rooms in the house.[33] The U.S. study found families that did not call a poison control centre were more likely to be African-American (Adj. OR 2.66 {95% CI= 1.22-5.80}) and have lower educational levels (Adj. OR 1.42 {95% CI=0.68-2.96})[32] (Cohort Table 4, Case-Control Table 4).

4.4.5 Risk factors for burns

Risk factors for burns were the focus of two case-control studies. One was from Brazil[60] and the other was from Ghana[59] (Case-Control Table 1). Both studies were general in focus (host, social and physical environments). The outcome measure for case selection was hospital admission for a burn in the Brazilian study[60] and burn as evidenced by a visible scar in the study from Ghana.[59] SES data were collected through personal interviews in both studies (Case-Control Table 2). With the exception of maternal education (which did differ in operational definition), measures of SES and operational definitions varied between the two studies (Case-Control Table 3).

The Brazilian study found that burn risk was higher in crowded homes (Adj. OR 2.22 {95% CI=1.06-4.65}),[60] while the Ghanaian study found no SES measures to be significant[59] (Case-Control Table 4).

4.5 Canadian Studies

Only six[21,22,29,38,48,49] (11%) of the 57 studies included were Canadian: three were analytical studies[38,48,49] and three were evaluations of intervention strategies.[21,22,29] Of the analytical studies, one was a cohort study examining factors associated with injury in the first three years of life[38] and the other two were case-control studies.[48,49] One of these examined the strength of risk factors for pedestrian and cyclist injuries.[48] The other examined whether there is an increased frequency of deficits in impulse control and/or vigilance among children involved in pedestrian/cyclist injuries.[49] The cohort study used a telephone survey to obtain self-reported measures of household income and maternal level of education, employment status and first language.[38] It found that children of unemployed mothers were at increased risk of injury but no increased risk for children with poorly educated mothers or coming from lower income households. The two case-control studies, by the same author, used different measures of SES. One used a telephone survey to obtain self-reported measures of maternal level of education and employment status, family size and parental assessment of environmental risk.[48] The other used a telephone survey to obtain self-reported measures of maternal level of education and occupation of the head of the household, and calculated a "Green score" for each family.[49] Both studies found a protective effect for increased parental education.

All three of the intervention studies were NRCTs. Two of these evaluated the effectiveness of educational programs in increasing bicycle helmet use,[21,22] the other the effectiveness of an infant car seat loan program on increasing car seat use.[29] In the bicycle helmet studies, measures of SES used were not very specific. For example, one stratified municipalities as being "poor" or "average rich" (the authors did not report how this was assessed)[21] and the other used census data to classify neighbourhoods as "high," "middle" and "low" income.[22] In both studies, cyclist' SES was classified by where he or she was observed riding. Both found increased helmet use in higher SES areas. The third study used self-reported level of education completed via a telephone interview and found that better educated mothers reported restraint use more often in both groups.[29]

Discussion

Chapter 5

This systematic review proved challenging for our team. Despite all members having formal training in epidemiology and/or statistics, we had great difficulty in trying to determine the category of study design used for several studies. Even after referring to classic examples of study design, some studies proved difficult to categorize. For example, one study interviewed caretakers of children seen for poisoning in an emergency centre and subsequently divided them into those who called and those who did not call a poison control centre prior to the injury.[32] It was then determined whether demographic, behaviour or knowledge differences existed between the two groups. As described, this study had aspects of case-control, cohort and cross-sectional designs. A second study examined injury details as well as safety perspectives and concerns among parents in areas of low and high injury incidence, which also differed with respect to SES.[41] This study also appeared to be either a case-control or a cross-sectional survey due to its "snapshot" examination of data. In both cases it was decided, by consensus, to classify these as cohorts.

5.1 Measures of SES

The majority of the potentially relevant studies did not have a control group and were therefore excluded from review. When measures of SES were examined among all studies, we encountered 47 different measures used in various frequencies and most had several different operational definitions, (Appendix D). The most frequently used measures were ethnicity, maternal or paternal education and household income; however, 21/47 of the SES measures (44.7%) were used less than three times in the 195 articles containing an SES measure. The variety in the measures of SES and their operational definitions renders synthesis of evidence difficult. The results of such an exercise are of questionable validity.[74]

5.2 Methodological Quality

When making programming and policy decisions, the evidence used in making those decisions must be the highest quality possible. When conducting analytic studies to identify risk factors for injury, experimental studies would provide the strongest evidence. However, the use of this study design is difficult in injury prevention because individuals cannot be randomly allocated to be exposed to risk factors such as poverty. As a result, investigators are left with weaker study designs, such as cohort, case-control and cross sectional designs. We excluded cross-sectional studies because the lack of a control group means that the strength of evidence they provide is much weaker. The case-control studies and cohort studies we included accounted for 68% of all the studies in the review. Even when well designed, these types of studies are open to several forms of bias or systematic error. Overall, we found the quality of reporting to be poor, suggesting that either the designs were not as strong as they could have been or that authors failed to report information to allow us to assess quality adequately.

We also found the quality of reporting to be poor for the intervention studies included. Studies with stronger designs, such as RCTs, allow a greater sense of confidence in study results and in policy and programming decisions stemming from those results. For some interventions in injury prevention, such as legislative strategies, it is not feasible to do RCTs. However, there are many other interventions where they are feasible, such as educational strategies. Only four of the 18 intervention studies included in this review were RCTs and the others were NRCTs and pre-post studies. The quality of reporting for both the RCTs and the NRCTs was low in comparison to reports of RCTs published in other content areas.[75] It is important to recognize, however, that not only is the type of study design important, but also with what kind of quality the study was implemented. For example, a well-designed RCT may be poorly conducted and therefore provide less valid results than an NRCT that was not only well designed but also carefully conducted and reported.

As a result of the poor quality of reporting, specific syntheses of the study results are done with caution and several of our recommendations are related to the design and reporting of injury research. This finding is not unique to the area of injury research, and quality of reporting is a major issue in most systematic reviews. Further, as Klein[76] points out, studies addressing societal influences on childhood injury may not have reliable findings because some methods of data collection may be biased. For example, because differences may exist in the utilization of medical services by level of SES, medical records may not be an accurate source of SES-related injury information. Similarly, personal interviews as well as self-report questionnaires may be unreliable as differences in perception of what constitutes an injury may exist between levels of social class.

5.3 SES Measures: Which Is Most Informative?

Due to the multifactorial nature of injuries, research into its causal factors is complex.[77] When examining the issue of SES, we are not only facing this complexity, but also other issues such as proxy respondents (parents) and proxy measures of SES. The nebulous nature of SES means that researchers are required to use measures of the socio-economic circumstances of a family and their environment to describe a concept that is still not completely understood. Thus before, or in addition to, looking at the influence of SES, researchers may need to ask "what is the most informative measure of SES to use?"

Our review of this literature found hundreds of different measures of SES if differing operational definitions are taken into account. The selection of an exposure or confounding variable is usually done with some degree of understanding of the underlying mechanism that ties that variable to the outcome of interest. Yet, we really do not have a lot of evidence to help us understand the underlying mechanism in the case of socio-economic status and childhood injury. We do know, however, that host, agent and environmental factors each play a role in injury occurrence and therefore must all be considered when attempting to explain the relationship between childhood injury and SES.

5.4 Multiple Factors

5.4.1 Parenting

Although measures of parental education are not necessarily related to SES, nor is education necessarily related to intelligence, it seems an intuitive step to assume that a parent's education will play a role in their ability to parent their children and to assess their needs and abilities. Grossman and Rivara have suggested that many less educated parents may have poor knowledge of child development and thus may be more likely to mismatch abilities to task.[78] Thus, one possible mechanism for the increased risk of injury for families in lower SES strata may be less complete understanding and knowledge of their child's abilities at different developmental stages. Paritsis et al.,[33] in their study of poisoning in a Greek community, also suggested that educational level may influence a parent's ability to assess what is and what is not a poisoning hazard.

Parental supervision may play a part in the relationship between SES and childhood injury, but it is unclear whether lack of supervision is due to lack of knowledge or the existence of competing priorities or resources. West et al.'s quasi-experimental study examining the effect of a traffic club on road safety suggested striking differences in both the amount and quality of supervision among parents from different socio-economic backgrounds.[24] The reason for such differences is not clear. It may be that families of lower SES tend to be headed by young, relatively uneducated single parents. These parents may also have fewer resources such as time, money or social support and may be less able to watch their children closely. Parents in higher SES groups may have more resources and be able to stay home with children, hire full-time caregivers or use their more extensive social networks. The direct relationship between social support and risk of pedestrian injury found in Robert's study of pedestrian injury in children of single parents would support this.[54] However West et al. also suggested that parents from manual occupation groups may be more interested in fostering independence among their children and therefore may not supervise their children's activities as closely as those from other occupational groups.[24]

The notion of scarce resources is also suggested by family size. Studies finding that children from households with multiple children or households with younger children were at increased risk of injury support this notion.[54,60,67,70] However, other studies did not find an increased risk.[32,34,37,43,46-48] Family size may not be a proxy measure of SES but child characteristics may be increased risk taking as a result of younger siblings mimicking older ones. On the other hand, others might suggest that larger families have an advantage of older children watching over their younger siblings.

5.4.2 Economics

Measures of parental occupation and income are also not necessarily related to education or intelligence. Yet again, it is reasonable to assume that parents with professional occupations will have higher incomes and that families with higher incomes will have more material resources to ensure their children's basic safety needs are met. Two Canadian studies evaluating programs to increase bicycle helmet use in schools in both low- and high-income areas suggest that cost may be a barrier to helmet acquisition.[21,22] However, a recent program comparing free helmets to helmets available for a nominal fee in Seattle, Washington, found no difference in use.[79]

Our review detected mixed findings for education and occupation in the analytical studies. For every study that found increased risk for children of mothers with lower educational levels[34,39,40,46,48,49,60,65,70] or children of fathers with manual occupations,[44,46,55,56] there was another that did not find these relationships.[33,38,43,45,59,62,63,66] Due to the variation in operational definition of the measures among studies, it is not clear whether these differences are real or due to this variation. Even if they are real, because we do not understand exactly how parental education, occupation or family income might affect a child's injury risk, these results are interesting but not very useful for policy making and program planning.

5.4.3 Environment

Environmental measures of SES may also play a role in explaining the relationship between childhood injury and SES. A number of the analytical studies showed that children of lower SES have a higher rate of pedestrian injuries than children of higher SES.[47,49-57] These children may be at increased risk of living in poor quality housing or multifamily residences as a result of having lower family incomes. Their neighbourhoods are more likely to be crowded, with fewer adequate play spaces and more traffic. This mechanism is strongly supported by the results of Agran et al. who specifically investigated the role of the physical and traffic environment in child pedestrian injuries.[50] Pless et al. also reported a strong correlation between bicycle and pedestrian injury and safety of the physical environment in which children played.[48]

SES may also reflect social environment, since the experience of poverty cannot be separated from social context. Several of the studies examining bicycle helmet use suggested that lower SES was predictive of lower helmet use.[22,71,72] If most neighbourhood children are not wearing helmets, then no helmet may be a social norm. DiGuiseppi et al.'s findings that helmet use was associated with the presence of helmeted companions may support this premise.[20]

5.5 Programming and Policy: Where Do We Go from Here?

Program planners and policy makers need to be aware of the issues related to SES and to recognize that injury prevention strategies that work in areas of higher SES may not work as well in areas of lower SES. A recent review of the socio-economic influences on unintentional injury in childhood from Britain found very few intervention studies specifically targeting economically deprived children.[80] As a result, there is work to be done to identify strategies that work in lower SES populations. It would seem reasonable that program developers need to take into account differing levels of SES in their target populations, modify strategies accordingly and then evaluate them. In an extensive review regarding the impact of poverty and social disadvantage on child health in general, Jolly et al. have reiterated this idea.[81]

One further consideration is that most of the intervention studies in this review focused on educational interventions. Many experts involved in injury prevention question the effectiveness of educational strategies on their own. They suggest that legislated and enforced modification to injury agents and physical environments are more promising approaches. Until these approaches are more widely used and evaluated, we will not know whether they are better able to prevent injury in lower SES populations.

One of the areas not touched on by the studies we examined was the issue of higher SES groups being at greater risk to some types of injury due to activities such as snowboarding, skiing and in-line skating. Canadian injury death rates have been reported to be lowest for those in middle-income neighbourhoods, not high-income neighbourhoods, as might be expected.[1] However, given that no studies were found, it is not possible to comment on this issue at this time.

With respect to evidence from Canadian studies, there were discordant results with respect to SES measures found to be predictive of increased risk of injury. This may be the result of differing operational definitions. Other Canadian studies used inexact measures of SES (applying population data to individuals) which may result in ecological fallacy. Realistically, there were too few Canadian studies to draw specific conclusions.

5.6 Limitations of This Review

There are several limitations of this review that should be considered. The first relates to how various databases categorize certain variables. For example, EMBASE, the European database, categorizes an adolescent as 13 to 17 years, whereas in CINAHL an adolescent is 13 to 18 years. As the population of interest in this review was 0 to 19 years, some potentially relevant articles may have been excluded. Second, we did not search reference lists of all the potentially relevant documents identified by our various search strategies. The large number of potentially relevant documents together with time constraints for completing the review made this impossible to do accurately. Furthermore, the nature of the relationship we examined would have meant either retrieving every article on the reference lists or limiting retrieval to those titles that indicated SES was part of the study.

Also, we did not search the gray literature (i.e. literature that is difficult to identify, locate and retrieve) extensively, although several documents came to light through our international experts. Five of the articles pulled from the review of review articles also could not be found in the computerized databases. A graph of document distribution by source can be found in Appendix C4. Reasons for exclusion of these articles from the search were related to the fact that they either did not have specific end-points (e.g. biking or burns) and were general, or did not have one of the SES indicators recorded in the search strategy. These studies represent 21% of those studies included in the review and may reflect the difficulty in trying to identify studies that address the relationship between SES and childhood injury. There is a chance that we may have missed other studies because of these limitations, but considering the broad nature of our search strategy and the number of citations screened, we believe this risk to be small. In addition, the studies included may have suffered from other design weaknesses such as confounding by variables other than SES and sample size problems, which we did not address. Our challenges in categorizing study design and assigning primary outcomes certainly suggest that design was an issue. Lastly, although evaluation of injury prevention initiatives specifically targeting low SES populations would have had great value, it was beyond the scope of the current project.

Conclusions and Recommendations

Chapter 6

Following an extensive search, this systematic review found 57 relevant studies that examined the relationship between childhood injury and SES. Few of these studies primarily examined this relationship, with most including SES measures as possible confound or co-factors. Based on the reporting of these studies, the majority were methodologically weak and subject to substantial bias. The many different measures of SES used in these studies also make it difficult to synthesize results. As a result, formulation of a distinct hypothesis regarding the role that material and economic prosperity plays in child injury is unlikely. Even in those studies where a relationship was reported, there were few data to provide plausible mechanism. In addition, only six of the studies were conducted in Canada.

Although the quality of reporting was not high and there were some discordant results, there is enough evidence presented in these studies to require continued study into this issue. There is also enough evidence to suggest a need for policy and program planners to take socio-economic disparity into account when designing and evaluating injury prevention policies and programs for Canadian children and youth. Particularly in the areas of bicycle helmet and child passenger restraint use, there was evidence to suggest the need for innovative strategies when targeting a population, including those of lower SES.

As recognition of injury as an important public health issue continues to grow in Canada, so too will injury prevention efforts. This will involve both policy and programming decisions. Decision makers will need to assess which prevention strategies are most effective for each injury type and for differing populations. Many of these decisions are currently being made without sufficient knowledge and understanding of the relationship that SES plays with respect to injury incidence and compliance with injury-preventing actions. As has been demonstrated by this review, this is due in part to both the quantity and quality of research in this area. This review has underscored a critical need for research specifically addressing the nature and causes of this relationship. Our specific recommendations are:

1. **A standardized set of measures of SES and/or a Canadian index should be developed and distributed so that all researchers are using the same measures.** To simplify any subsequent synthesis of evidence in this area, it is necessary to have a standardized set of operationally defined measures of SES for Canadians. This would facilitate collaboration, comparisons between populations, etc.

2. **All injury prevention programs, their strategies (educational, engineering, legislative) and their evaluations should take into account the SES of the target population.** What has worked in one area or population may not work in another. Despite the discordant results from the studies examined, the overall view of the relationship between childhood injury and SES cannot be ignored. There is therefore a need to conduct pilot studies before launching large, expensive campaigns to ensure that all SES groups are addressed appropriately. The effects of programs by all SES strata need to be evaluated.

3. **Injury prevention program planners need to develop innovative initiatives designed to increase uptake of safety measures and decrease environmental hazards in lower SES populations.** There is evidence to suggest that strategies designed for a broader population do not work for sub-populations with lower SES. Furthermore, there has been little research directly targeting lower SES groups. More emphasis should be put on the development and enforcement of legislative strategies to assess whether these have more of an impact on these groups.

4. **RCTs should be considered the preferred research design for investigating injury control interventions; other designs should be used when an RCT is impossible to implement.** The most valid and reliable evidence regarding the effectiveness of any intervention designed to prevent childhood injuries will come from properly conducted RCTs. This design provides the best opportunity for controlling for potential confounds and co-factors such as socio-economic status. Only with this level of evidence can program planners and policy makers make informed decisions. Funders of injury prevention research in Canada should encourage the use of this design.

5. **Specific standards for reporting of non-RCT intervention studies and analytic epidemiological studies should be developed.** Standards for reporting have been developed for RCTs. A similar set of standards for non-RCT intervention studies and analytic epidemiological studies would allow us to better evaluate study quality and greatly assist efforts aimed at synthesizing the results of these studies. Although this issue is not particular to studies in injury control, as many of the studies being conducted are not RCTs or experimental in nature, it is important to the area of injury control.

6. **A coordinated national research agenda that focuses on understanding the mechanism(s) by which SES leads to an increased injury incidence and lower uptake of safety measures should be developed.** This research agenda must involve multidisciplinary research groups and include social scientists in addition to the traditional researchers. A nationally coordinated research agenda will decrease duplication of effort, allow the development of expertise across Canada and encourage collaboration.

7. **Health Canada should establish an infrastructure for a national network of collaborating childhood injury control research centres with sufficient funds to design and conduct epidemiological and program evaluation in childhood injury.** Such a network is needed because of the difficulties in doing research in childhood injury prevention (accruement of enough subjects to achieve an adequate sample size) and the relatively small number of individuals currently working in this area. Linkages with centres conducting research in related areas such as social welfare is crucial. Such linkages would prevent duplication of efforts and would allow for coordination and enhancement of existing work. Such a collaboration could provide leadership in implementing high quality injury prevention research using the above mentioned standardized set of SES measures, and could begin to correct existing deficits in knowledge regarding Canadian children, injury and socio-economic status.

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